IN THE SPECIFICATION

Please substitute the paragraph beginning at page 4, line 22 and ending at page 5, line 16 to read as follows:

According to an aspect of the present invention, a circuit board testing apparatus is adapted for testing continuity and/or short-circuit of wirings formed on a circuit board. First terminals of the wirings are irradiated with an electromagnetic wave so that electrons are discharged from the first terminals by photoelectric effect. Discharged electrons are trapped by an electrode which is electrically biased to have a higher potential than that of the second terminals of the wirings, thereby causing an electric current to flow through the wirings via the electrode. Existence of an open-circuit and/or a short-circuit ~~of~~ in the wirings is judged based on the current flowing the wirings.

According to an embodiment of the invention, the first terminals are irradiated with the electromagnetic wave alternatively, one at a time. Also, the second terminals of the wirings are supplied with voltage one at a time. Alternatively,

a voltage may be supplied to the second terminal of a wiring adjacent to a selected wiring of which first terminal is irradiated by the electromagnetic wave.

Please substitute the paragraph beginning at page 6, line 4 and ending at page 6, line 11 to read as follows:

For the testing of a circuit board including wirings having electric conductors formed on the surface or inside of the circuit board and electrically connected to respective first and second terminals, there may be preferably provided a second electrode to be capacitively coupled to the electric conductors. The short-circuit between wirings is judged based on a current value when the one of the first terminals is irradiated and another current value when another of the first ~~terminal~~ terminals is irradiated.

Please substitute the paragraph beginning at page 7, line 2 and ending at page 7, line 5 to read as follows:

It may be preferable to enclose the first terminals of the

wirings within an airtight closed space, and ~~depressurizes~~ depressurize the closed space. The degree of depressurization is preferably 10^{-2} atm.

Please substitute the paragraphs beginning at page 11, line 11 and ending at page 14, line 7 to read as follows:

The pad portions 12a are arranged at a small pitch to adapt to the pads connected to semiconductor chips, whereas the ball grid portions 12b are arranged at a larger pitch as compared with the pitch of the pad portions 12a. In this embodiment, the circuit board 10 having the above construction is referred to as a work to be tested by the apparatus. However, it is needless to say that a circuit board to be tested by the apparatus is not limited to the above mentioned type. It should be noted that although the drawing shows only three wirings for clarification, actual ~~circuited~~ circuit boards are formed with a great number of wirings on the top and bottom surfaces or in the inside or on both of the two surfaces and the inside of the circuit board.

The apparatus is provided with a work holder 21 to carry one piece of a circuit board as a work 10. The work holder 21 is

movable between a test position (position shown in FIG. 1) where the work 10 is tested and a load/unload position (not shown) where the work 10 is loadable to the work holder 21 or unloadable from the work holder 21. A work driving mechanism 22 drivingly ~~reciprocate~~ reciprocates the work holder 21 back and forth between the test position and the load/unload position in accordance with a control signal from a controller 30 which controls an overall operation of the apparatus.

A lower fixture unit 40 is provided below the work 10 at the test position. The lower fixture unit 40 includes a plurality of conductive spring probes 41 which are arranged in correspondence to the ball grid portions 12b of the respective ~~wrings~~ wirings 12. The lower fixture unit 40 further include a multiplexer 42, and a lower fixture base (not shown) which is movable toward and away from the work 10 while carrying the probes 41 and the multiplexer 42 thereon. The lower fixture base is coupled to a lower fixture unit driving mechanism 43. The lower fixture unit driving mechanism 43 drivingly moves the lower fixture base toward and away from the work 10 in response to a control signal from the controller 30.

An upper fixture unit 50 is provided above the work 10 at

the test position. The upper fixture unit 50 includes a cap-like housing which is so configured as to cover a certain region on one surface of the work 10. The housing includes a plate electrode 51 made of a transparent electrode and shielding members 52 made of, e.g., a rubber. The upper fixture unit 50 is movable toward and away from the work 10 as an integral unit. With this arrangement, when an upper fixture unit driving mechanism 55 coupled to the upper fixture unit 50 is actuated in response to a drive command from the controller 30, the upper fixture unit 50 is moved to the work 10. When an end portion 52a of the shielding members 52 come into contact with the surface of the work 10 the shielding member deforms and abuts against the surface of the work 10 due to counter pressure. The end portion 52a serves to make airtight the enclosure surrounded by the housing 50 and the work 10. In this embodiment, the end portion 52a of the shielding member 52 itself is deformable for the sealing of the enclosure. However, this invention is not limited to this arrangement. A seal member may be provided between the shielding member 52 and the work 10 as the case may be.

An atmosphere controller 70 is operatively connected to the housing 50 to depressurize the closed space SP. When the work is

tested, the closed space SP is preferably held at a vacuum degree of 10^{-2} atm. In the case of a vacuum degree lower than 10^{-2} atm, the electron discharge rate decreases. On the other ~~hands~~ hand, higher vacuum degree increases the electron discharge rate. However, a longer time is required until the closed space SP reaches a desired higher vacuum degree, consequently increasing the test time. According to experiments of the inventors, it was confirmed that sufficient photo-electrons are discharged under the pressure of 10^{-2} atm which can be attained in a relatively short time.

Please substitute the paragraph beginning at page 15, line 8 and ending at page 15, line 10 to read as follows:

In this embodiment, the electromagnetic wave emitting section 61 emits ultraviolet laser light beams for the purpose of causing the photoelectric effect. However, this invention is not limited to the arrangement of the embodiment, and visible light beams, infrared light beams or its equivalent may be used.

Please substitute the paragraph beginning at page 21, line

10 and ending at page 21, line 18 to read as follows:

FIG. 3 is a flowchart showing an operation of the circuit board testing apparatus shown in FIG. 1. First, an untested work (circuit board) 10 is loaded onto the work holder 21 at the load/unload position by a handling device (not shown) provided in the testing apparatus or a manual operation by an operator (in Step S1). Then, the controller 30 starts to control operations of the various parts of the apparatus to execute the following steps S2 to S9 so as to test ~~short~~ shorts and ~~open-circuit of~~ open-circuits in the work 10.

Please substitute the paragraph beginning at page 23, line 17 and ending at page 24, line 16 to read as follows:

Upon completion of depressurization, as shown in FIG. 5, the multiplexer 42 is activated in accordance with a selection command from the controller 30, and one wiring 12 (target wiring) is electrically connected to the minus output terminal of the power source 80 (in Step S53). Thus, the first target wiring is selected with the voltage of the power source 80 being applied

between the electrode 51 and the ball grid of the selected wiring. Then, ultraviolet laser light in the form of pulses or ~~other~~ another type of electromagnetic wave is irradiated onto the pad portion 12a of the selected wiring at a predetermined timing shown in FIG. 5 (in Step S54).

During irradiation, the current detecting section 90 measures the current which changes as shown in FIG. 5 (in Step S55). It is judged whether the target wiring is in an open circuit state or not based on the measured current value (in Step S56). A judgment regarding an open circuit can be performed merely based on presence or absence of a detected output. Preferably, however, an open circuit may be judged by comparison of a current value measured with a reference circuit board, with a current measured with the circuit board under test. A series of operations from selection of the target wiring (Step S53) to judgment regarding open circuit (Step S56) are repeated until it is judged that all the wirings ~~has~~ have been tested in Step S57.

Please substitute the paragraph beginning at page 27, line 5 and ending at page 27, line 17 to read as follows:

Furthermore, in this embodiment, since the plate electrode 51 has such a shape as to cover a group of wirings to be tested, the following effects can be obtained. Specifically, this arrangement does not need to transversely move the plate electrode 51 to match with the location of the target wiring, and allows an electromagnetic wave to pass through the plate electrode 51 and irradiate onto the target wiring while fixing the plate electrode 51. This arrangement enables one to simplify the construction of the upper fixture unit 50 and the upper fixture unit driving mechanism 55 and shorten a test time. Further, since the plate electrode 51 constitutes a portion of the housing 50, the number of parts constituting the apparatus can be lessened.

Please substitute the paragraph beginnings at page 28, line 17 and ending at page 30, line 22 to read as follows:

After the target wiring pair is selected in Step S63, an electromagnetic wave is irradiated onto the pad portion of the first target wiring in response to an operation command from the controller 30 (in Step S64). Thereupon, electrons are discharged

from the pad portion, and an electric field is generated between the plate electrode 51 and the pad portion (one terminal) of the first target wiring by application of a voltage to the plate electrode 51 and the second target wiring if the target wiring pair is in a short circuit state. As a result, the electrons discharged from the first target wiring due to photoelectric effect by electromagnetic wave irradiation are electrically attracted by the plate electrode 51 aided by the existence of the electric field, and a conductive pathway is established through which a current runs from the power source 80 and returns thereto via the plate electrode 51, the first target wiring, the short-circuited portion, and the second target wiring to thereby securely measure a current running through the target wiring pair.

On the other hand, in the case where the target wiring pair is not in a short circuit state, the aforementioned conductive pathway is not established, and a current value detected by the current detecting section 90 is zero or exceedingly lower than a current value detected in the case where the target wiring pair is in a short circuit state. Thus, this arrangement enables one to precisely and stably determine whether the target wiring pair

is in a short circuit state by detecting a current running through the target wiring pair.

In this embodiment, during irradiation, the current detecting section 90 measures a current and outputs a signal corresponding to the current as a detected output (in Step S65). It is judged whether the target wiring pair is in a short circuit state based on the measured current value (in Step S66). A judgment regarding short circuit can be performed simply based on presence or absence of a detected output. Preferably, however, it is judged whether the target wiring pair is in a short circuit state by comparing a current value measured with a reference circuit board with a current value measured with the circuit board under test. A series of operations from selection of the target wiring pair (Step S63) to judgment regarding short circuit (Step S66) are repeated until it is judged that all the wirings on the work 10 has been tested in Step S67.

In the above mentioned first embodiment, a transparent electrode is used as the plate electrode 51. This invention is not limited to that arrangement. Alternatively, a mesh electrode may be provided in place of the plate electrode. In the altered arrangement, it is preferable that a housing is made of a

transparent glass material or the like and a mesh electrode is attached on an inner surface of the housing. In such an altered arrangement, an electromagnetic wave L passes through the housing and clearances between the mesh electrodes to be irradiated onto a target wiring. This altered arrangement enables one to obtain a similar effect as the first embodiment.

Please substitute the paragraph beginning at page 31, line 18 and ending at page 32, line 5 to read as follows:

The modified apparatus is not provided with a plate electrode for applying a voltage. In the modified apparatus, a voltage is applied to all or part of the wirings arranged in the vicinity of a target wiring such that the wirings may efficiently capture the electrons discharged from the target wiring upon irradiation of an electromagnetic wave. To provide this arrangement, in the modification, the plus terminal of a power source 80 is connected to one terminal of a multiplexer 45, whereas the minus terminal of the power source 80 is connected to the opposite terminal of the multiplexer 45 via a current detecting section 90.

Please substitute the paragraph beginning at page 34, line 3 and ending at page 34, line 13 to read as follows:

On the other hand, in the case where the target wiring 121 is in discontinuity, the aforementioned conductive pathway is not established, and a current value detected by the current detecting section 90 is zero or exceedingly lower than a current value detected in the case where the wiring 121 is in continuity. This arrangement enables one to precisely and stably determine whether the target wiring is in continuity by detecting a current running through the target wiring 121, and enables the controller 30 to determine whether the target wiring 121 is in continuity or in discontinuity based on a measured current detected by the current detecting section 90.

Please substitute the paragraphs beginning at page 37, line 5 and ending at page 38, line 21 to read as follows:

As mentioned above, according to the first embodiment and the modification, an electric field is generated between an electrode portion and one terminal of a target wiring, and a

conductive pathway is established by attracting electrons discharged from the one terminal of the target wiring by photoelectric effect due to electromagnetic wave irradiation onto the electrode portion aided by the existence of the electric field. Thereby, short and open-circuit of the target wiring can be accurately and stably tested.

FIG. 8 is a schematic illustration of a circuit board testing apparatus according to a second embodiment of the invention. FIG. 9 is a block diagram showing an electric configuration of the testing apparatus in FIG. 8. A circuit board testing apparatus in accordance with a second embodiment is adapted to test a circuit board 210. As shown in FIG. 8, the circuit board 210 is constructed in such a manner that a number of wirings 212, 321 and 322 are formed on a base plate 211. It is to be appreciated that the actual circuit board or substrate has many wirings formed thereon but that only three wirings are shown in the drawing. Description will be made ~~herein after~~ hereinafter with reference to the wiring 210 as a representative of the other wirings, for ~~the~~ convenience unless other wirings are required to be referred to for particular explanation.

Terminals 212a and 212b of the wiring 212 are formed on the

circuit board 210 or substrate to be connected with an electronic component mounted on the circuit board 210 or external wirings. A conductive portion 212c is formed on the surface of or inside the circuit board 210 to electrically connect the terminals 212a and 212b. In this embodiment, described is a case where the circuit board 210 having the above construction is tested as a work. It is needless to say that the work to be tested by this embodiment is not limited to the aforementioned circuit board. In this embodiment, the terminals 212a and 212b are provided on the respective surfaces of the circuit board 210, and the conductive portion 212c which connects the terminals 212a and 212b is provided inside the base plate 211. Alternatively, terminals may be formed on either one of the surfaces of the circuit board, and a conductive portion for connecting the terminals may be formed on the same or opposite side surface of the circuit board.

Please substitute the paragraph beginning at page 39, line 20 and ending at page 40, line 2 to read as follows:

A conductive probe 281 is provided at the test position.

When the lower fixture unit 240 is moved to the test position, the metallic plate 241 provided on the lower fixture unit 240 is rendered into contact with the conductive probe 281. Thus, the metallic plate 241 is electrically communicable with a power source ~~70~~ 270 which is described later.

Please substitute the paragraph beginning at page 40, line 15 and ending at page 41, line 1 to read as follows:

An upper fixture unit 250 is arranged above the work 210. The upper fixture unit 250 is provided with a housing 251 in the form of a cap so as to cover terminals 212a, 321a, 321aa and 322a formed on the upper surface of the work 210. The housing 251 is formed with an exhaust port 254 on a side wall thereof, and is made of, e.g., a transparent silica glass. Also, the housing 251 is provided with a seal member 252 made of, e.g., rubber on a free end of a side wall of the housing 251. Further, a transparent plate electrode 253 is attached or deposited on an inner upper surface of the housing 251.

Please substitute the paragraph beginning at page 41, line

16 and ending at page 41, line 21 to read as follows:

The exhaust port 254 formed on the housing 251 is communicated with an exhausting device 290 via an exhaust pipe (not shown). When the exhausting device ~~90~~ 290 is activated based on a control signal from the controller 201, the air inside the closed space SP is drawn out to depressurize the interior of the closed space SP to about 10^{-2} atm.

Please substitute the paragraph beginning at page 42, line 10 and ending at page 42, line 19 to read as follows:

An electromagnetic wave irradiator 260 is provided in the apparatus to irradiate an electromagnetic wave to a terminal connected to one wiring (target wiring) alternatively selected from a plurality of wirings ~~12~~ 212 for the test. The electromagnetic wave irradiator 260 includes an electromagnetic wave emitting section 261 which emits an electromagnetic wave L in response to an operation command from the controller 201. An electromagnetic wave scanning section 262 directs the electromagnetic wave L to a desired location on the work 210 in

response to an operation command from the controller 201.

Please substitute the paragraph beginning at page 50, line 8 and ending at page 50, line 18 to read as follows:

Next, an operation of the circuit board testing apparatus in accordance with the second embodiment is described with reference to FIG. 11. FIG. 11 is a flowchart showing operations of the testing apparatus shown in FIG. 8. When an untested work (circuit board) 210 is loaded on the lower fixture unit 240 positioned at a load/unload position by a handling device (not shown) incorporated in the testing apparatus or a manual operation by an operator (in Step T1), the controller 201 start to control operations of the various parts of the apparatus to execute the following steps T2 to T11 so as to test shorts and ~~opens circuit of~~ open-circuits in the work 210.

Please substitute the paragraph beginning at page 52, line 6 and ending at page 53, line 3 to read as follows:

When the routine is progressed to Step T5, the closed space

SP defined by the housing 251 and the work 210 has been depressurized to a predetermined pressure of about 10^{-2} atm. In this state, the controller 201 controls the operative angle of the galvanometer 262 so that laser ~~beams~~ beam is focused on the terminal 321a of a target wiring 321 (in Step T61). The laser beam emitted from the electromagnetic wave irradiator 260 is an ultraviolet laser beam having a wavelength of 266 nm. Electrons discharged from the terminal 321a due to photoelectric effect are electrically attracted by the plate electrode 253 aided by the existence of the electric field, and a current runs through the conductive pathway. The current is measured by the current detecting section 280 (in Step T62). The current measurement is continued for a time (in Step T63). Next, the controller 201 calculates a charged amount of electricity based on the current values detected by the current detecting section 280 (in Step T64). Specifically, the charged amount Q is calculated by integrating the measured current values on time-basis. Then, the controller 201 determines whether the target wiring 321 is in a normal continuous state or other state based on the calculated charged amount Q (in Step T65).

Please substitute the paragraph beginning at page 53, line 20 and ending at page 54, line 12 to read as follows:

As mentioned above, in the apparatus in accordance with the second embodiment, the metallic plate 241 provides a capacitive coupling of the metallic plate 241 with the wiring or wirings to be tested. The capacity provided by the capacitive coupling of the metallic plate 241 and the target wiring varies depending on whether the target wiring is in continuity or in ~~other~~ another state. Accordingly, the amount of electricity charged at the capacitor comprised of the metallic plate 241 and the target wiring varies as the capacity varies. According to the second embodiment, currents running through the predetermined conductive pathway via the capacitor are detected, an amount of electric charges that have been charged at the capacitor is calculated, and it is judged whether the target wiring is in a short circuit state or an open circuit state based on the calculated charged amount. This arrangement enables precise and stable test of the wirings formed on a circuit board in a contactless manner.

Please substitute the paragraph beginning at page 57, line

15 and ending at page 58, line 8 to read as follows:

Upon completion of current measurements, the controller 201 calculates a change of the charged amount Q on a time-basis by integrating the current values detected by the current detecting section 280 (in Step T616), and determines whether the first terminal 321a and the second terminal 321aa are in continuity based on the result of calculation (in Step T617). Specifically, in the case where the actually measured charged amount Q varies before and after the timing t1, as shown in FIG. 14A, it is judged that the first terminal 321a and the second terminal 321aa are not connected with each other. On the other hand, in the case where the changed amount Q does not vary before and after the timing t1, as shown in FIG. 14B, it is judged that the first terminal 321a and the second terminal 321aa are connected with each other. Thus, a test with respect to one target wiring is completed. The aforementioned series of operations with respect to the wiring test are repeated until the test is completed with respect to all the wirings of the work 210 (in Step T618).

Please substitute the paragraph beginning at page 58, line

17 and ending at page 59, line 5 to read as follows:

On the other hand, in the case where the test is performed by selecting terminals which are not designed to be continuous, e.g., in the case of the terminals 321a and 322a, if the terminals 321a and 322a are in discontinuity, it is judged that the wiring test between the terminals 321a and 322a has "PASSED", whereas if the terminals 321a and 322a are in continuity, it is judged that the terminals 321a and 322a are in a short circuit state. Thus, in the testing apparatus in accordance with the second embodiment, a judgment as to whether an arbitrary combination of terminals of wirings formed on a circuit board is in continuity or discontinuity enables one to test ~~opens~~ open-circuits and shorts ~~of~~ in the wirings.

Please substitute the paragraph beginning at page 60, line 3 and ending at page 60, line 13 to read as follows:

In this embodiment, it is required to monitor the current for a time period from the start of current flow until the current flow is suspended so as to calculate a charged amount Q

for the monitored time by integrating the monitored current values. In view of this, this embodiment adopts a technique of securely detecting travel of electric charges by continuously measuring currents for a time being while the electromagnetic wave is being irradiated. Alternatively, change of currents may be monitored until the current falls down to a predetermined level, current may be measured continuously until the current or its integration becomes lowered than a predetermined value.

Please substitute the paragraph beginning at page 60, line 22 and ending at page 61, line 9 to read as follows:

Alternatively, a test may be performed by combining the test made in the second embodiment and any of the above mentioned alternative tests. As an example, the following arrangement is appreciated. An electromagnetic wave is irradiated onto the first terminal to perform a test with respect to a wiring (target wiring) connected to the first terminal. When the target wiring is judged to be in an open or short circuit state, it is subsequently tested whether the target wiring relative to the other ~~wiring~~ wirings are in continuity. This arrangement enables

detection of the portion and the nature of the defect of the tested circuit board.

Please substitute the paragraphs beginning at page 62, line 13 and ending at page 64, line 20 to read as follows:

In the second embodiment, providing the metallic plate 241 on the lower fixture unit 240 to oppose the metallic plate 241 to the work 210 and connecting the metallic plate 241 to the power source 270 enables ~~to function~~ the metallic plate 241 to function as the second electrode portion. For example, in the case where the work 210 is a multi-layered substrate in which each of a plurality of layers formed with a wiring pattern are placed one over another, it is impossible to secure a sufficient capacity between a target wiring and the metallic plate 241 because the other wirings, a power source, or a ground layer may intervene between the target wiring and the metallic plate 241. As a result, it is highly likely that a precise and stable test cannot be performed. In such a case, functioning the wiring formed in the circuit board, e.g., the ground layer as the second electrode portion enables one to perform a wiring test precisely and

stably.

FIG. 15 is a diagram showing a testing apparatus as a first modification of the second embodiment in which a ground layer formed in a circuit board functions as the second electrode portion.

The testing apparatus as the first modification is adapted to test the electric state of a circuit board 220. As shown in FIG. 15, the circuit board 220 is formed with a plurality of wirings 222 on a base plate 221. Each wiring 222 includes terminals 222a and 222b which are formed on the respective opposite surfaces of the circuit board 220, and a conductive portion 222c which is formed on the surface or inside the circuit board 220 and is electrically connected to the terminals 222a and 222b. A ground layer 223 is provided inside the base plate 221 to apply a reference potential to an electronic circuit established on the circuit board 220 to implement predetermined operations of the apparatus. The ground layer 223 extends substantially over the entire surface of the circuit board 220 except portions allowing passage of the conductive portions such as 222c, and is connected to a terminal 223a which is formed on the upper surface of the circuit board 220 so as to be

electrically connected to an external ground. In this modification, described is a case where the circuit board 220 having the above construction is used as a work to be tested by the testing apparatus of the first modification. It is needless to say that the work to be tested by the apparatus is not limited to the aforementioned circuit board. The inventive apparatus may test a circuit board, for example, in which a ground layer ~~23~~ 223 is a conductive member in the form of a mesh.

In this modification, a lower fixture unit 240 includes a non-conductive support block 243, whereas in the arrangement of the second embodiment, the lower fixture unit 240 includes the metallic plate 241 and the insulating film 242 as shown in FIG. 8. The arrangement of the modification is advantageous in that the modification does not require an electrode having a large surface area in the lower fixture unit 240 since the ground layer 223 formed inside the circuit board 220 serves as the second electrode portion. It should be appreciated that the arrangement of the second embodiment shown in FIG. 8 also enables one to perform the same test as in this modification.

Please substitute the paragraph beginning at page 66, line 1

and ending at page 66, line 10 to read as follows:

In this modification, the ground layer 223 is electrically connected to the current detecting section 280 via the conductive probe 257. Each of the wirings 222 formed on the circuit board is capacitively coupled to the ground layer 223. In this way, the ground layer 223 satisfies a requirement as the second electrode portion, namely, the requirement that the second electrode should be connected to an external power source and capacitively coupled to a target wiring inside the circuit board. Thus, the ground layer 223 can ~~be functioned~~ function as the second electrode portion in the first modification.

Please substitute the paragraph beginning at page 66, line 15 and ending at page 67, line 3 to read as follows:

Specifically, in the first modification, a current due to photoelectric effect runs through the current detecting section 280 from the ground layer 223 via the conductive probe 257, whereas in the second embodiment, a current runs through the current detecting section 280 from the metallic plate 241 via the

conductive probe 281. The other operations of the testing apparatus in the first modification are the same as the testing apparatus in accordance with the second embodiment shown in FIG. 8. The first modified testing apparatus enables one to precisely and stably test ~~as to~~ whether a target wiring is in a short circuit state or an open circuit state, and test as to whether there is ~~a~~ continuity between a selected pair of terminals.

Please substitute the paragraph beginning at page 71, line 7 and ending at page 72, line 3 to read as follows:

As mentioned above, in the second modification of the second embodiment, the upper fixture unit 250 is constructed in such a manner that the terminal 233b-1 of the wiring 233b formed on the circuit board 230 is exposed outside the closed space SP, and the opposite terminal 233b-2 of the wiring 233b is housed inside the closed space SP. Electrically connecting the terminal 233b-1 to the power source 270 via the conductive probe 258 in the above arrangement enables ~~to function~~ the wiring 233b to function as the first electrode portion to capture the photoelectron discharged from the terminal irradiated by electromagnetic wave.

As a result, this modification does not require a plate electrode 253 which is provided in the testing apparatus in accordance with the second embodiment shown in FIG. 8, and the housing 251 is so configured as to secure a minimal surface area for covering the terminal of a wiring to be tested with respect to the work 230. Accordingly, this arrangement enables a smaller testing apparatus while reducing a volume of the closed space SP which is subjected to depressurization. Thus, a wiring test can be performed in a shorter time because a time required for depressurization is shortened due to the reduced volume of the closed space SP.

Please substitute the paragraph beginning at page 72, line 23 and ending at page 73, line 22 to read as follows:

Further, combination of the modifications of the second embodiment may be applicable. For instance, combining the first modification and the second modification enables ~~to function~~ a wiring formed on a circuit board (i.e., work) which is connected to a power source to function as the first electrode portion and ~~function~~ a ground layer formed on the circuit board to function

as the second electrode portion so as to perform a wiring test.

As mentioned above, in the second embodiment and its modifications, since a high potential is applied to the first electrode portion which is disposed in the vicinity of the terminal to be connected to the target wiring, electrons discharged from the terminal due to photoelectric effect upon irradiation of an electromagnetic wave are securely attracted and trapped on the first electrode portion. Furthermore, since the second electrode portion is so arranged as to be capacitively coupled to the target wiring, the electrons that have run through the first electrode portion are securely detected as a current running through a closed circuit via the capacitor comprises of the target wiring and the second electrode portion. Thus, a wiring test is performed based on the detected current. This arrangement enables testing of ~~opens and shorts circuit of~~ open circuits and short circuits in the target wiring without electric contact of both surfaces of the circuit board with the upper and lower fixtures.

Please substitute the paragraph beginning at page 75, line 13 and ending at page 76, line 2 to read as follows:

A lower fixture unit 440 is provided below the work 410 at the test position. The lower fixture unit 440 includes a plurality of conductive spring probes 441 which are arranged to respectively connected with the corresponding ball grid portions 412b of the respective ~~wrings~~ wirings 412. The lower fixture is further provided with a multiplexer 442, and a lower fixture base (not shown) which is movable toward and away from the work 410 while holding the probes 441 and the multiplexer 442 thereon. The lower fixture base is coupled to a lower fixture unit driving mechanism 445. The lower fixture unit driving mechanism 445 drivingly moves the lower fixture base toward and away from the work 410 in accordance with a control signal from the controller 430.

Please substitute the paragraph beginning at page 78, line 22 and ending at page 79, line 3 to read as follows:

In this embodiment, ultraviolet laser light beams are emitted using the UV lamp 470 for the purpose of raising the photoelectric effect. However, this invention is not limited to

a UV lamp, and visible light beams, infrared light beams or its equivalent may be used.